

ORIGINAL ARTICLE

Black adolescents' support to the family and educational outcomes: Differences by household income

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Funding information

Institute of Education Sciences, Grant/Award Number: R305B140009; Stanford Data Science Fellowship; National Science Foundation

Abstract

Using a strengths-based approach, this study investigated whether Black adolescents' provision of different types of support to family (chores, childcare, emotional, financial support) was associated with their educational outcomes (school engagement, grades, suspensions), and whether these associations differed by household income levels. The study used the nationally representative National Survey of American Life Adolescent Supplement data ($N = 1170$, 52% Female, ages of 13–17). Supporting the family was associated with both educational success and risk, depending on the type of support and household socioeconomic resource levels. Across income groups, providing emotional support was associated with greater school engagement. Among low-income youth only, completing chores was associated with higher school engagement and grades, whereas providing childcare was associated with lower grades.

KEYWORDS

Black adolescents, education, family support

1 | INTRODUCTION

Adolescence is a unique developmental transition when youth are increasingly capable of contributing to their families by providing practical, emotional, or even financial support to parents, siblings, and extended relatives (Fuligni, 2019). A growing literature has investigated how adolescents' provision of support to the family is linked to their educational outcomes, helping to illuminate family processes that impact educational success during this critical developmental period (Armstrong-Carter & Telzer, 2021; Hardway & Fuligni, 2006; Telzer & Fuligni, 2009). However, research to date

has focused on samples of White, Latinx, or Asian adolescents. Researchers know less about how Black adolescents' provision of support to the family is associated with educational outcomes, even though family support networks are a key feature of daily life for Black adolescents (Cross, Taylor et al., 2018). Further, there may be significant within-group heterogeneity among Black adolescents, given the diversity of this group in the United States (Cross, Taylor et al., 2018; Gaylord-Harden et al., 2018). In particular, associations between Black adolescents' support to the family and their educational outcomes may vary by household income, because supporting the family could be either more beneficial or more taxing depending on the material resources and opportunities available within the home (Armstrong-Carter et al., 2019). Using a strengths-based framework, this study draws on a large, nationally representative sample of Black adolescents. This study investigated (1) whether adolescents' provision of different types of support to the family (i.e., chores, childcare, emotional, and financial support) was associated with their educational outcomes (i.e., school engagement, grades, and number of suspensions); and (2) whether adolescents' support to the family divergently relates to their educational outcomes depending on level of annual income in the household.

1.1 | Black adolescents' provision of support to family and the strengths-based approach

Family support networks are an integral part of daily life for most families (Weisner, 2001), but research is sparse about family support networks among Black families (Cross, Taylor et al., 2018), even though Black adolescents make up almost 15% of the population in the United States (Census Bureau, 2020). Initial research among Black families focused on adults' provision of support, and conceptualized adolescents as the recipients of support (Sarkisian & Gerstel, 2004). However, more recent work has emphasized that Black adolescents also *provide* significant amounts of support to the family (e.g., Cross, Nguyen et al., 2018; Cross, Taylor et al., 2018; Taylor, 2016; Taylor, Forsythe-Brown et al., 2017; Taylor, Skipper et al., 2022). It is particularly helpful to understand Black adolescents' provision of support to the family via the strengths-based conceptual framework (Fergus & Zimmerman, 2005). The strengths-based framework is an approach that emphasizes individuals' personal strengths and capacities to engage positively with the world around them, for example by helping their parents, siblings, and other family members in the home (Fuligni, 2019). In particular, studying adolescents' provision of support to the family from a strengths-based approach can help to illuminate their positive contributions to the lives of their families and households (Fuligni, 2019).

Black adolescents' provision of support to the family ranges from completing chores, to caring for siblings and other children in the home, to providing emotional support, to making financial contributions (Cross, Taylor et al., 2018). Chores are tangible tasks such as cleaning, cooking, shopping, or yardwork. Childcare includes taking care of a younger sibling, cousin, or other child. It could be occasional babysitting or more ongoing, intense childcare responsibilities. Emotional support involves listening to or giving advice to a loved one (Tsai et al., 2016), and financial support involves earning and providing wages to the family (Mortimer, 2010). It is important for researchers to differentiate between these distinctive types of support because they are qualitatively distinct from one another, and are quite different daily experiences (Cross, Taylor et al., 2018; Tsai et al., 2016). Further, each type of support may impact adolescents' wellbeing divergently (Tsai et al., 2016). For example, because emotional support involves adolescents' awareness and response to another person's challenges or worries (Tsai et al., 2016), providing emotional support may relate to adolescents' own adjustment and behaviors differently compared to their provision of chores (Armstrong-Carter & Telzer, 2021; Tsai et al., 2016). In one study, providing chores support to the family was linked with positive learning-related behaviors (e.g., studying, completing homework), but providing emotional support to the family was not (Armstrong-Carter & Telzer, 2021). As another example, providing high levels of childcare could be uniquely taxing if adolescents take on a level of responsibility or "parental" role that is typically reserved for adults (Burton, 2007; Hooper et al., 2014), as ongoing caregiving can interfere with school attendance, learning, and academic performance (Bauman et al., 2006; Diaz et al., 2007; Kavanaugh, 2014).

1.2 | Supporting the family is linked to educational outcomes

A growing number of studies have linked adolescents' provision of family support to their educational outcomes such as school engagement and academic achievement (Armstrong-Carter & Telzer, 2021; Fuligni, 2001; Fuligni et al., 1999; Hardway & Fuligni, 2006; Lam et al., 2016). Understanding how adolescents' support to the family relates to their educational outcomes is important for two reasons. First, adolescents increasingly are capable of making meaningful contributions to the family (Fuligni, 2019), and helping the family is an almost universal feature of adolescents' daily lives (Weisner, 2001), including among Black adolescents (Cross, Nguyen et al., 2018; Cross, Taylor et al., 2018). Accordingly, adolescents' daily helping behaviors in the home are likely to "spill over" into other domains of their lives, such as experiences in school and with school work (Armstrong-Carter & Telzer, 2021; Fuligni, 2019). For instance, helping the family could help to shape adolescents' sense of self-efficacy and purpose (Fuligni, 2019), which in turn promotes their engagement and performance at school. Alternatively, helping the family could detract time from the day that otherwise could be spent on homework or studying. Second, educational outcomes during adolescence represent critical developmental milestones which set the stage for life-long educational attainment, employment opportunities, and material resources, as well as physical and emotional wellbeing across the lifespan (Lövdén et al., 2020). As such, it is important to investigate a variety of family processes and behaviors in the home that may either promote or undermine educational success during this developmental transition.

Prior research linking adolescents' support to the family to their educational outcomes has focused on samples of White, Latinx, and Asian adolescents (Armstrong-Carter et al., 2019). The experiences of Black adolescents are underrepresented. These prior studies have shown mixed results. On the one hand, White, Latinx, and Asian adolescents who provided more instrumental support to the family (a combination of both chores and childcare) spent more time studying and performed better on homework, quizzes, and tests (Armstrong-Carter & Telzer, 2021; Hardway & Fuligni, 2006). Further, those who believed they should support and assist their family more strongly valued academic achievement (Fuligni, 2001). In addition, although academic motivation rapidly decreases during the transition to high school, this decline was smaller for adolescents with a stronger sense of family obligation (Fuligni, 2001). On the other hand, adolescents who provided more frequent instrumental support showed lower grade point averages (GPA) in three studies of White, Latinx, and Asian adolescents (Fuligni et al., 1999; Lam et al., 2016; Telzer & Fuligni, 2009), and one other sample composed of 11% Black adolescents (Armstrong-Carter & Telzer, 2021). In the same sample, providing emotional support was not associated significantly with GPA or school engagement behaviors such as homework completion (Armstrong-Carter & Telzer, 2021).

Providing high levels of childcare during adolescence can be indicative of adolescents taking on a caregiving or parenting role that typically is performed by adults, and therefore may be uniquely taxing and linked to emotional and academic risk (Burton, 2007; Hooper et al., 2014). Indeed, in predominantly White samples, adolescents' provision of childcare has been associated with interference with attendance and learning, although it also has been linked to higher levels of school engagement (East & Hamill, 2013; Kramer & Hamilton, 2019). Similarly, providing financial support during adolescence has been shown to interfere with educational opportunities (Bridgeland et al., 2006; Mortimer, 2010). For instance, those who earned and provided wages for the family showed small but significant decreases in grades over the year (Staff et al., 2009). At the same time, there are other benefits associated with work experience during adolescence such as growth in self-confidence, self-efficacy, responsibility, and agency (Mortimer, 2010), which could contribute to school success. In sum, although extant research suggests that adolescents' provision of support to the family is associated with educational outcomes, the directions of the associations have been mixed. Mixed findings are likely in part because many studies conflate different types of support (e.g., chores and childcare), or investigate different types of support separately in different samples with different measures, or measure different educational outcomes.

One way to clarify whether supporting the family is linked to educational success or risk factors is to differentiate carefully between types of support and to measure multiple different educational outcomes. Specifically, differentiating between types of support and testing them simultaneously in the same sample allows for consistent methodology

and measures, accounts for shared statistical variance, and eases the comparison of findings pertaining to different types of support. In addition, examining multiple different educational outcomes (e.g., grades, engagement, and suspensions) may shed light on which specific types of support relate to which particular educational outcomes. For instance, providing instrumental support to the family (i.e., chores and childcare) was correlated with higher school engagement but lower grades (Armstrong-Carter & Telzer, 2021). Further, although prior studies have focused on school engagement and grades (e.g., Fuligni et al., 1999; Lam et al., 2016; Telzer & Fuligni, 2009), no known studies have examined how supporting the family relates to experiences of suspension, which partially reflects adolescents' behavioral engagement and adjustment in school.

It is important to understand how support to the family relates to educational outcomes among Black adolescents. Although Black adolescents have historically been marginalized and continue to face systemic educational barriers in the United States, Black adolescents use positive developmental assets every day in order to overcome adversity and achieve educational success (Gaylord-Harden et al., 2018). Indeed, Gaylord-Harden et al. (2018) have argued that Black adolescents' high levels of positive and prosocial engagement facilitates their adaptive calibration to contextual challenges. Black adolescents' participation in the family is one indication of positive and prosocial engagement. Yet, few studies have examined how Black adolescents' provision of support to the family is linked to their educational outcomes. In one study, Black adolescents who experienced more stressful demands from the family and also less consistent family routines showed lower school achievement (Taylor, 2016), although this study did not examine adolescents' provision of positive supportive behaviors. Examining Black adolescents' provision of support to the family can extend prior research and help to shed light further on how Black adolescents achieve educational success.

1.3 | Differences by household income

Black adolescents and families in the United States are a socioeconomically diverse group (Census Bureau, 2020). Given this socioeconomic diversity, there is a need to investigate within-group heterogeneity among Black adolescents and their families (Cross, 2021; Gaylord-Harden et al., 2018; Syed et al., 2018; Taylor et al., 2013; Taylor et al., 2022). Indeed, the association between Black adolescents' provision of support to the family and educational outcomes may vary by household income level. Household income influences the resources and supports available to the adolescent and their family members, so supporting the family may be more or less beneficial for youth from low-income households, compared to high-income households. On the one hand, low-income families face number of financial stressors which may make adolescents' provision of support more burdensome or taxing, if they do not have sufficient material resources or support available to them (Burton, 2007). Alternatively, adolescents from low-income families who provide more support to the family could be *protected* from contextual challenges typically experienced in low-income homes (e.g., neighborhood crime, resource deprivation), because supporting the family can serve to integrate youth more fully into the family system and create mutually beneficial, shared support networks (Cross, Taylor et al., 2018). Consistent with this notion, a few studies have shown that youths' prosocial behavior to peers can be protective against educational and behavioral risk in contexts of adversity, in predominantly White and South Asian samples (Armstrong-Carter, Miller, et al., 2021; Flouri & Sarmadi, 2016). Given the importance of support networks within Black adolescents' families, and the variability in socio-economic status within the Black population, it is important to examine how the interplay between Black adolescents' provision of support to the family and household income relates to their educational success.

1.4 | The current study

The current study investigated two research questions: (1) Is Black adolescents' provision of support to the family (chores, childcare, emotional, and financial support) associated with their educational outcomes? Educational outcomes were indexed via three markers: school engagement, academic grades, and number of out-of-school suspensions. It was hypothesized the provision of support would relate to educational outcomes differently depending

on the type of support, but there was no specific hypothesis for the direction of the associations given the mixed prior research to date. (2) Does the association between Black adolescents' provision of support to the family and educational outcomes differ for those from high-income versus low-income households? There were two competing hypotheses. On the one hand, providing higher levels of support could be more taxing in low-income households, because there are have fewer resources, and therefore associated with worse educational outcomes. On the other hand, providing higher levels of support could be relatively more beneficial for adolescents in low-income households, and, because it provides a sense of self-efficacy and close interpersonal connections with family, and serves as a protective factor from socio-economic risk. Additional sensitivity analyses were tested to further explore the findings for school suspensions, which are described further below.

2 | METHOD

2.1 | Participants

The sample comprised 1,170 Black adolescents (51.88% female, $M_{\text{age}} = 15.03$, $SD = 1.42$, $\text{Range} = 13\text{--}17$). Data were drawn from the National Survey of American Life Adolescent Supplement (NSAL-A). The NSAL-A is a youth-centered supplement of the National Survey of American Life (NSAL) parent study (Jackson et al., 2004). The NSAL is a nationally representative, comprehensive study of mental health and disorders among African American and Black Caribbean adolescents in the United States. All African American and Black Caribbean participants self-identified racially as Black. Black Caribbean participants were defined as adolescents who traced their ethnic heritage to a Caribbean nation, but resided in the United States, racially classified as black, and spoke English. African Americans self-identified as Black but did not identify any ancestral ties to a Caribbean country. All respondents were selected from targeted geographic areas in proportion to the African American and Black Caribbean populations, making the NSAL the first national sample of participants from different racial and ethnic groups living in the same social and geographic contexts. The data were collected by the Program for Research on Black Americans at the University of Michigan from February 2001–June 2003. The dataset is a stratified, multistage area probability sample. According to national poverty thresholds, adolescents predominantly came from low-income households (60.05%), followed by high-income households (22.16%) and middle-income households (17.78%).

2.2 | Procedure

Every household with an adult participating in the NSAL was screened for an adolescent living in the home. Adolescents were then invited to participate using a random selection procedure. In instances where more than one adolescent in a household was eligible for participation, up to two adolescents were chosen for the study, and when possible, the second adolescent was of a different sex. Accordingly, some households have non-independence of data, so all analyses were adjusted (i.e., using statistical weighting) for non-independence in selection and in non-response rates between individuals in the same household (Seaton et al., 2008). The majority of the interviews were administered face-to-face using a computer in the home, but 18% were administered either entirely or partially by telephone. The overall response rate was 80.6%. Participants were financially compensated (\$50).

2.3 | Measures

2.3.1 | Provision of support to the family

Adolescents' provision of support to the family was indexed via four variables: chores support, childcare support, emotional support, and financial support. *Chores support* was assessed by the item: "How often do you help them [your

family members] with regular chores such as shopping, cleaning or yard work?" *Childcare support* was measured by the item: "How often do you help your family with childcare?" *Financial support* was assessed by the item: "How often do you give them [your family] financial assistance?" Each of these three questions used the same response format: (4) very often, (3) fairly often, (2) not too often, or (1) never. The internal consistency of these three items together was low (Cronbach's $\alpha = .41$), suggesting that examining these items separately was appropriate (and not combining them into a single composite). Provision of *emotional support* was assessed using a three-item index (Cronbach's $\alpha = .67$). Respondents were asked how often they: (1) "Make your family feel loved and cared for?," (2) "Listen to them [your family] about their private problems and concerns?," and (3) "Express interest and concern in their [your family's] wellbeing?" Adolescents responded to each item via a four-point Likert-type scale which ranged from "never" to "very often." Values for the three items were summed, yielding a range of 3 to 12. All support variables are continuous (i.e., chores support, childcare, emotional support, and financial support), with higher values indicating more frequent support, and lower values indicating less frequent support.

2.3.2 | Educational outcome

There were primary three educational outcomes: school engagement, earned academic grades, and number of suspensions. *School engagement* was assessed using a ten-item scale: Participants were asked how true each of the following statements were when they were in school: (1) "Most of my teachers treat(ed) me fairly," (2) "I (care/cared) a lot about what my teachers (think/thought) of me," (3) "I (like/liked) school," (4) "I (care/cared) a lot about what my teachers (think/thought) of me," (5) "Getting good grades (is/was) important to me," (6) "Homework (is/was) a waste of time," (7) "I (like/liked) my teachers," (8) "I (try/tried) hard at school," (9) "I (feel/felt) as if I (don't/didn't) belong at school," (10) "Most of the things I learn(ed) in school are unimportant." Response formats used a 4-point Likert-type scale ranging from "not true at all" to "very true." Negative items were reverse-scored. Values were averaged, resulting in a range of 1 to 4 ($M = 3.38$; $SD = .45$, with higher values indicating higher levels of school engagement (Cronbach's $\alpha = .71$).

For *grades*, adolescents reported whether they earned mostly As, Bs, Cs, Ds, or Fs in school. Self-reported grades were coded categorically: 1 = Mostly Ds and failing grades, 2 = Mostly Cs, 3 = Mostly Bs, 4 = Mostly As. Prior studies have found strong correlations (Pearson's $r = .76$ to $.97$) between self-reported and objective grades gathered from academic transcripts (Hishinuma et al., 2001; Thomas et al., 2009). This suggests that students' reports of grades earned tend to be fairly accurate and unbiased.

For *number of suspensions*, adolescents were asked to indicate the number of times they had experienced out of school suspensions, and responded numerically. About half of the adolescents had never been suspended (48%). The number of suspensions ranged from 0 to 11 ($M = 1.75$, $SD = 2.82$). As described briefly in the results and fully in the supplementary materials, two additional variables pertaining to suspensions were tested as part of the sensitivity analyses: *time suspended* and *likelihood of suspension*.

2.3.3 | Household income

Adolescents' parents reported their household income level. Household income ranged from at or below the poverty threshold to greater than 400% of the poverty threshold. Annual household income ranged from 1 to 6 corresponding to the following values: "\$1 to \$10,000," "\$10,001 to \$25,000," "\$25,001 to \$50,000," "\$50,001 to \$75,000," "\$75,001 to \$100,000," and "Over 100,000." The majority of adolescents (60%) were from households with incomes at or below 200% of the poverty threshold (i.e., "low-income"). According to prior research, and based on federal guidelines, these households often are not able to meet their basic needs (Jiang et al., 2015). In addition, 18% of adolescents were from households with incomes between 201–300% of the poverty threshold (i.e., "middle-income," which approximate the national median (\$43,318 for a family of four in 2003; Department of Health and Human Services, 2003). Finally,

22% of adolescents were from household incomes above 300% (i.e., “high-income,” with around 25% higher than the national median, given that 300% of the poverty threshold was \$55,200 in 2003 (U.S. Census Bureau, 2003).

2.3.4 | Covariates

Several individual and household characteristics that may be associated with adolescents’ educational outcomes were controlled for in regression analyses. *Ethnicity* was a dichotomous variable indicating whether the adolescent self-identified as African American or Black Caribbean. For analyses, African American adolescents served as the reference group. *Sex* was coded as female (reference) or male and *age* was measured in years. *Region* consisted of four categories: Northeast, North Central, West, and South (reference). The *number of children* was a continuous measure reflecting the number of children in the adolescents’ household. This variable did not include the study participants themselves. *Neighborhood quality* was measured using a 7-item scale ($\alpha = .79$). Adolescents were asked “How true is each of the following statements about your neighborhood?”: (1) I feel safe in the neighborhood during the day, (2) I feel safe in the neighborhood at night, (3) neighbors would help in an emergency, (4) neighbors are friendly, (5) neighbors trust each other, (6) neighbors look out for one another, (7) people often get mugged or attacked in my neighborhood. Adolescents responded on a 4-point Likert-type scale ranging from “not at all” to “very.” Items were summed, yielding a range of 4 to 28; higher values reflect a higher perceived neighborhood quality.

2.4 | Statistical analysis

Descriptive analyses included means and standard deviations for continuous variables, and % per group for grades, because it is a categorical variable. Differences in levels of different types of support were compared via paired sample t-tests.

The primary analyses were regression models. The specific types of regressions varied by the outcome variable. When school engagement was modeled as the outcome, linear regressions were used because it was a continuous measure. When the number of suspensions was modeled as the outcome, negative binomial regressions were used because it was a continuous measure heavily weighted toward zero (48% of participants had never been suspended). When grades were modeled as the outcome, generalized ordered logistic regressions were used with the option that does not assume proportional odds, because grades were categorical (Williams, 2016). The odds ratios from generalized ordered logistic regressions are interpreted somewhat counter intuitively (Williams, 2016). Specifically, the odds ratios from generalized ordered logistic regressions are interpreted in contrast to the comparison group - in this analysis, adolescents’ probability of receiving “Mostly As”. Therefore, odds ratios less than 1 indicate a greater probability of receiving that outcome (e.g., “Mostly Bs”) compared to “Mostly As”. Odds ratios more than 1 indicate a greater probability of receiving “Mostly As” compared to “Mostly Bs” (Williams, 2016).

There were two primary regression models. Model 1 tested direct associations between adolescents’ provision of each type of support to the family (i.e., chores, childcare, emotional, and financial support) and their educational outcomes (i.e., school engagement, number of suspensions, and academic grades). Model 2 tested how the associations between adolescents’ provision of each type of support to the family and their educational outcomes varied by their level of household income. Specifically, two interaction terms were created by multiplying the standardized values of each support variable and standardized values of household income level. This yielded four interaction terms total. These four interaction terms were then included as simultaneous predictors in Model 2. All regression models controlled for adolescents’ age, ethnicity, sex, number of children in the household, region, and neighborhood quality. Missing data were low (<1%) for all variables except provision of childcare (missing 4.8%), and handled with listwise deletion. Participants with missing data had significantly lower grades and school engagement, more frequent suspensions, and provided lower levels of child care and emotional support, compared to participants without missing data ($p < .05$). There were no other differences in study variables.

Significant interactions were probed further using the simple slopes technique (Aiken et al., 1991) by testing the associations between support and educational outcomes for adolescents with high (1 SD above the mean) and low (1 SD below the mean) levels of household income. Analyses were conducted in Stata Version 17 (StataCorp, 2021). Secondary models, described below and presented fully in the Supplementary Materials, tested for robustness of the results pertaining to school suspensions. Specifically, these sensitivity analyses modeled the amount of time suspended and the likelihood of suspensions as the outcomes, instead of the number of suspensions.

3 | RESULTS

3.1 | Descriptive statistics

Table 1 displays the distribution of sample characteristics for the full sample. On average across the full sample, adolescents were around the age of 15 ($M = 15.03$, $SD = 1.43$, $Range = 13-17$), and lived in households with approximately one other child ($M = .86$, $SE = 1.08$). On average, adolescents provided relatively higher levels of chores support ($M = 3.37$, $SD = .81$), compared to emotional support ($M = 3.29$, $SD = .61$), and to childcare ($M = 2.88$, $SD = 1.10$) and to financial support ($M = 2.20$, $SD = 1.10$). Paired samples *t*-tests indicated that the differences between all these types of support were significant ($ps < .05$).

Adolescents showed relatively high levels of school engagement ($M = 3.39$, $SD = .45$, $Range = 1-4$). About half of the adolescents had ever been suspended (52.56%), and on average adolescents were suspended about twice ($M = 1.75$, $SD = 2.82$) although this variable was skewed. Grades were relatively normally distributed, such that the majority of adolescents received either mostly Bs (45.61%) or mostly Cs (33.91%), and a relatively smaller proportion received mostly As (14.97%) or mostly Ds or failing grades (5.51%).

3.2 | Bivariate correlations

Table 1 also displays bivariate correlations between study constructs. Younger adolescents provided more chores support compared to older adolescents, but did not differ by any other type of support. Adolescents from homes with higher incomes provided lower levels of childcare and financial support, but did not differ in levels of chores support or emotional support. All types of support were correlated positively with each other, except for emotional and financial support, which were correlated negatively.

In addition, chores support was correlated positively with school engagement and grades but not the number of suspensions. Childcare was correlated positively with school engagement, but not with grades or number of suspensions. Emotional support was correlated positively with school engagement and grades but also with number of suspensions. Financial support was correlated positively with school engagement and number of suspensions, but not with grades. Black Caribbean youth experienced significantly fewer suspensions compared to African American youth, but did not differ in school engagement or grades.

3.3 | School engagement

Table 2 displays results from regressions testing associations between each type of support and school engagement, controlling for adolescent and family characteristics. Model 1 shows direct associations, whereas Model 2 shows interactions between support and household income. As shown in Model 1, emotional support was associated directly and positively with school engagement. This direct association was not qualified by any significant interactions in Model 2. This null finding suggested that the positive association be.

TABLE 1 Bivariate correlations and descriptive statistics for study constructs among the full sample (N = 1170)

	1	2	3	4	5	6	7	8	9	10	11	12
1 Female	1											
2 Black Caribbean	.03	1										
3 Age	.01	.05	1									
4 Neighborhood SES	-.07*	-.13***	.01	1								
5 Children	.06*	-.07*	-.16***	-.03	1							
6 Chores	-.01	-.05	-.12***	.06*	.09**	1						
7 Childcare	.21***	-.07*	-.04	.01	.23***	.22***	1					
8 Emotional Support	.12***	-.05	-.02	.14***	.04	.30***	.22***	1				
9 Financial Support	-.05	-.17***	.02	.00	.10*	.19***	.23***	.26***	1			
10 Household Income	.00	.13***	.05	.14***	-.11***	-.04	-.12	-.18***	.00	1		
11 School Engagement	.12***	-.06	-.09**	.12***	.02	.20***	.10***	.30***	.12***	-.02	1	
12 Suspensions	-.26***	-.12***	.07*	-.07*	.03	-.02	-.06*	-.09**	.05	-.10***	-.28***	1
13 Grades	.24***	.04	.01	.00	-.04	.08**	.00	.11***	-.05	.15***	.29***	-.26**
M	15.03	3.14	.86	3.37	2.88	3.29	2.2	2.76	3.39	1.75		
SD	1.43	.62	1.08	.81	1.1	.61	1.01	1.15	.45	2.82		
Min	13	1	0	1	1	1	1	1	1	1	0	
Max	17	4	4	4	4	4	4	4	4	6	4	11

Note: Numbers correspond to the labeled variables. *** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .1$. Support variables refer to adolescents' provision of support to the family. Mean values for categorical variables are not displayed (i.e., female sex, Black Caribbean ethnicity, and Grades), but percentages are reported in text. SES = socioeconomic

TABLE 2 Standardized linear regressions testing the association between help to the family, family income, and school engagement

	School engagement			
	Model 1		Model 2	
	Direct associations		Interactive associations	
	B	SE	B	SE
Female	.17**	(.06)	.16**	(.06)
Black Caribbean Ethnicity	−.07	(.11)	−.07	(.12)
Age	−.05*	(.02)	−.05*	(.02)
Neighborhood SES	.10*	(.04)	.10*	(.04)
North East Region	−.13	(.09)	−.14	(.08)
North Central Region	−.09	(.11)	−.10	(.10)
West Region	−.22	(.19)	−.22	(.19)
Number of Children in House	.00	(.03)	.01	(.03)
Chores	.10*	(.05)	.10*	(.05)
Childcare	.04	(.04)	.05	(.04)
Emotional	.24***	(.03)	.24***	(.03)
Financial	.05	(.03)	.04	(.03)
Income	−.00	(.03)	−.06	(.25)
Chores X Income			−.11*	(.04)
Childcare X Income			.13	(.08)
Emotional X Income			.04	(.03)
Financial X Income			−.06	(.05)
Constant	.60	(.38)	.56	(.36)
Observations	1141		1141	
R-squared	.146		.158	

SE in parentheses.

*** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .1$.

In addition, as shown in Model 1, chores support was associated directly and positively with school engagement. However, this direct association was qualified by a significant interaction in Model 2. Specifically, as shown in Figure 1, providing high levels of chores support was associated with higher school engagement only among adolescents from low-income households and not among adolescents from high-income households. There were no other direct or interactive associations with school engagement.

3.4 | Academic grades

Table 3 displays results from regressions testing associations between each type of support and grades — i.e., the likelihood of receiving mostly Ds or failing grades, mostly Cs, or mostly Bs (relative to mostly As), controlling for adolescent and family characteristics. Please see the note in the statistical analysis section about interpreting the odds ratios for generalized ordered logistic regressions, which is different from typical logistic regression models.

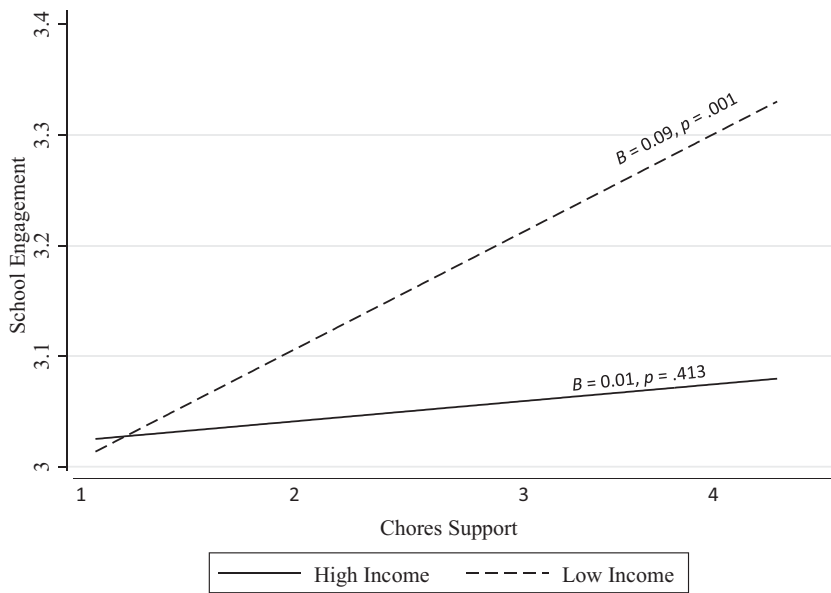


FIGURE 1 Chores support is linked positively to school engagement only among low-income youth

As shown in Model 1, providing high levels of chores support was associated with a 1.25 increase in the odds of earning mostly As compared to mostly Bs, and a 1.33 increase in the odds of earning mostly Bs compared to mostly Cs. (Note that the interpretation of odds ratios from generalized ordinal regression models is different from traditional logistic regression models, as described in the statistical analyses section). However, these direct associations were qualified by significant interaction in Model 2. Specifically, the interaction between chores support and household income predicting the likelihood of receiving Bs compared to Cs was significant. As shown in Figure 2, chores support was associated with higher grades (i.e., greater likelihood of receiving Bs compared to Cs) among adolescents from low-income homes but not among adolescents from high-income homes.

As shown in Model 1, childcare was not directly associated with grades. However, as shown in Model 2, the interaction between childcare and household income predicting the likelihood of receiving As compared to Bs was significant. As shown in Figure 3, providing childcare was associated with lower grades (i.e., lower likelihood of receiving As compared to Bs) among adolescents from low-income homes but not among adolescents from high-income homes.

3.5 | Number of suspensions

Table 4 displays results from negative binomial regressions testing associations between each type of support and the number of suspensions, controlling for adolescent and family characteristics. As shown in Model 1, there were no significant direct associations between support and the number of suspensions. However, as shown in Model 2, the interaction between chores support and household income predicted significantly the number of suspensions. Specifically, as shown in Figure 4, adolescents who provided chores support more frequently were suspended more frequently only if they lived in high-income homes. In contrast, providing chores support was not associated with the number of suspensions among adolescents from low-income homes.

TABLE 3 Generalized ordinal regression models testing the association between help to the family, income, and likelihood of receiving each grade compared to receiving mostly As. See note in the statistical analyses for how to interpret odds ratios from generalized ordinal regression models

	Direct associations				Interactive associations			
	Mostly Ds or Failing		Mostly Cs		Mostly Ds or Failing		Mostly Cs	
	Odds Ratio	SE	Odds Ratio	SE	Odds Ratio	SE	Odds Ratio	SE
Female	3.29**	(.131)	2.63***	(.45)	2.41***	(.43)	3.66**	(.44)
Black Caribbean Ethnicity	.69	(.44)	1.89*	(.53)	1.59	(.59)	.75	(.46)
Age	1.18	(.14)	1.06	(.07)	1.00	(.08)	1.25+	(.07)
Neighborhood SES	.87	(.17)	.90	(.06)	.97	(.10)	.85	(.06)
Northeast Region	1.35	(.98)	1.12	(.44)	.47	(.21)	1.23	(.41)
North Central Region	.57	(.32)	1.11	(.27)	1.31	(.37)	.60	(.27)
West Region	4.47	(4.79)	1.11	(.35)	1.77	(.88)	5.08	(.35)
Number of Children in House	1.24	(.28)	.94	(.08)	.94	(.12)	1.32	(.08)
Chores	1.45+	(.29)	1.33**	(.11)	1.25*	(.12)	1.40	(.13)
Childcare	.74	(.15)	.97	(.09)	.83	(.12)	.67*	(.09)
Emotional	1.48*	(.22)	1.14+	(.08)	.94	(.12)	1.34	(.08)
Financial	1.00	(.19)	.89	(.07)	.93	(.12)	1.10	(.08)
Income	1.32	(.27)	1.29**	(.12)	1.33*	(.17)	13.31	(3.33)
Chores X Income					.69+	(.13)	.73**	(.08)
Childcare X Income					.89	(.41)	.98	(.15)
Emotional X Income					.70	(.17)	.90	(.08)
Financial X Income					1.18	(.24)	.99	(.08)
Constant	.34	(.61)	.16+	(.15)	.05*	(.06)	.12	(.12)
Observations	1134		1134		1134		1134	

SE in parentheses.
*** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .1$.

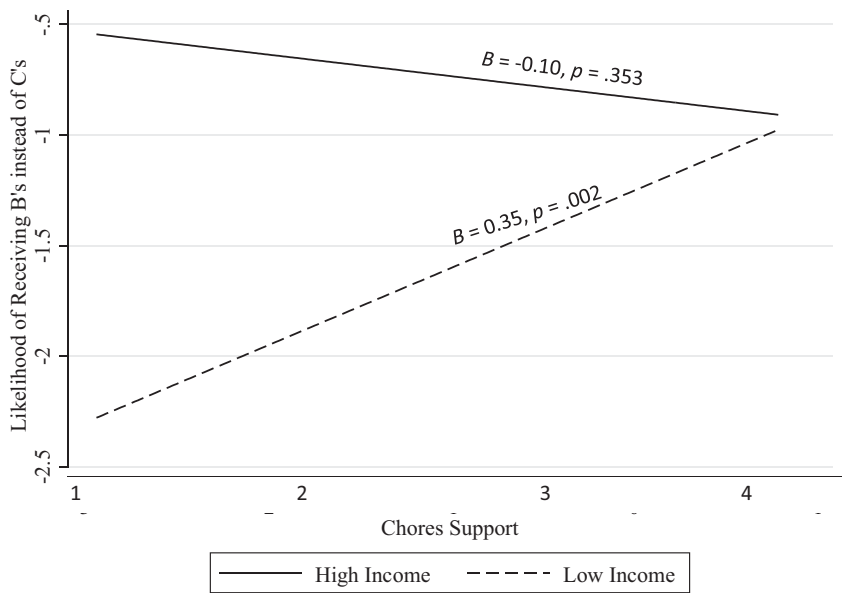


FIGURE 2 Chores support is linked to better grades only among low-income youth

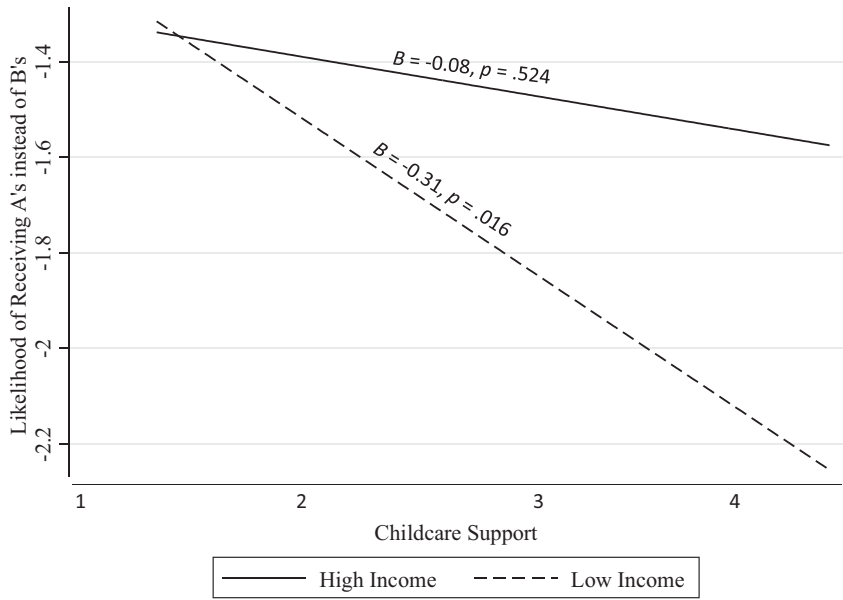


FIGURE 3 Childcare support is linked to worse grades only among low-income youth

3.6 | Sensitivity analyses

Additional sensitivity analyses tested whether support and household income directly or interactively predicted the amount of time suspended (a continuous variable), and the likelihood of suspensions (a categorical variable), instead of the number of suspensions. The Supplementary Materials describe these analyses in more detail and present the full results. In brief, the interaction between chores support and household income continued to predict significantly

TABLE 4 Negative binomial regressions testing the association between help to the family, income, and the number of times suspended

	Number of times suspended			
	Model 1		Model 2	
	Direct associations		Interactive associations	
	Odds Ratio	SE	Odds Ratio	SE
Female	.22***	(.05)	.22***	(.05)
Black Caribbean Ethnicity	.58*	(.14)	.58*	(.15)
Age	1.25***	(.07)	1.24***	(.07)
Neighborhood SES	.75**	(.07)	.76**	(.07)
Northeast Region	1.06	(.23)	1.07	(.27)
North Central Region	2.12*	(.74)	2.12*	(.74)
West Region	.59*	(.13)	.56**	(.12)
Number of Children in House	1.21 ⁺	(.12)	1.19 ⁺	(.12)
Chores	1.03	(.13)	1.01	(.13)
Childcare	.95	(.10)	.95	(.10)
Emotional	.92	(.08)	.94	(.08)
Financial	1.00	(.08)	1.01	(.08)
Income	.85	(.09)	.26 ⁺	(.18)
Chores X Income			1.29*	(.15)
Childcare X Income			1.03	(.21)
Emotional X Income			1.12	(.13)
Financial X Income			.96	(.10)
Constant	1.77	(1.64)	2.11	(1.86)
Observations	1126		1126	
R-squared	.117		.126	

SE in parentheses.

*** $p < .001$, ** $p < .01$, * $p < .05$, ⁺ $p < .1$.

the amount of time suspended, but not the likelihood of suspension. There were no other significant direct or interactive associations between provision of support and educational outcomes in any of the regression models. Sensitivity analyses also tested a variable that was the total intensity/frequency of instrumental support (i.e., the sum of the childcare, chores support, and financial support variables) as a predictor of adolescents' educational outcomes. This analysis showed that adolescents who provided more frequent total instrumental support reported higher levels of school engagement ($B = .12$, $SE = .02$, $p = .001$) when controlling for individual and family covariates, compared to their peers who provided less frequent total instrumental support. The total frequency of instrumental support was not associated with adolescents' grades or number of suspensions ($p > .05$).

4 | DISCUSSION

Supporting the family is a nearly universal feature of adolescents' daily lives (Fuligni, 2019), including among Black adolescents in the United States (Cross, 2021; Cross, Nguyen et al., 2018; Taylor et al., 2022). Grounded in a

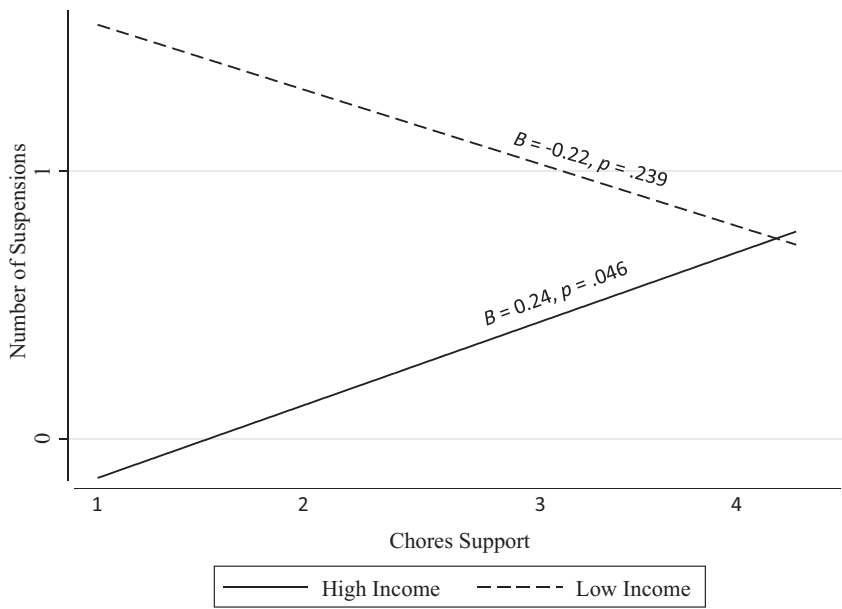


FIGURE 4 Chores were linked positively with suspensions only among high-income adolescents

strengths-based approach (Fergus & Zimmerman, 2005) and drawing on a large, nationally-representative sample, this study investigated how Black adolescents' provision of different types of support to the family related to their educational outcomes, and whether this association differed for those living in low-income compared to high-income households. Results revealed that supporting the family was linked divergently to both educational success and risk, depending on the type of the support and the household socioeconomic resources available. First, across income groups, emotional support was linked positively to school engagement. Second, among low-income youth only, providing more chores was linked to greater school engagement and better grades, whereas providing more childcare was linked to worse grades. Finally, adolescents from high-income homes who provided low levels of chores were suspended the least frequently. These findings underscore the importance of differentiating between qualitatively different types of support in future research, understanding the processes through which adolescents' support to the family relates to their educational outcomes, and investigating within-group heterogeneity among Black adolescents in the United States.

4.1 | Emotional support is linked to greater school engagement and better grades

Across the spectrum of household income levels, adolescents who provided emotional support to the family more frequently reported more positive school engagement and higher academic course grades. Providing emotional support involves awareness of another person's worries and feelings (Tsai et al., 2016), and adolescents who have these types of perspective-taking skills may be more able to engage positively in school by finding meaning and enjoyment in their academic tasks and routines. Further, adolescents who provide emotional support may be particularly mature and focused on engaging positively with both family emotional challenges and academic tasks. In turn, adolescents' positive emotional and behavioral engagement with school contributes to their greater academic performance over time (Fredricks, 2011). It also is possible that adolescents who provide more emotional support feel more self-efficacy, more useful, or greater role fulfillment and purpose, which further contribute to their engagement and achievement in school (Fuligni, 2019). Finally, when adolescents provide emotional support they also often receive emotional support

(Cross, Taylor et al., 2018; Morris et al., 2017), so these adolescents may live in mutually supportive home environments. Mutual, reciprocal exchanges of emotional support in the family may promote adolescents' school engagement and achievement by creating opportunities for adolescents to share their feelings with a trusted family member, process verbally their worries or anxieties, and form and maintain close familial relationships and emotional wellbeing.

The positive association between emotional support and school engagement and grades diverges from one prior study of predominantly Asian, Latinx, and White European adolescents (Armstrong-Carter & Telzer, 2021). That prior study found that providing emotional support was not associated significantly with school engagement behaviors or grades when controlling for adolescent and family characteristics (Armstrong-Carter & Telzer, 2021). Providing emotional support may be one of ways in which Black adolescents overcome systematic barriers to education and adaptively achieve educational success (Gaylord-Harden et al., 2018). Indeed, Black adolescents and families often place positive cultural emphasis on community ties, close interpersonal connections and mutual provision of support (DeFreitas, 2019; Gaylord-Harden et al., 2018; Lozada et al., 2017), so providing emotional support may be linked positively to educational engagement and achievement in this population.

4.2 | Chores linked to greater school engagement and grades among low-income youth

This study also found that Black adolescents from low-income households who helped the family more often with chores (e.g., shopping, cleaning, or yard work) showed higher levels of school engagement and better grades. In contrast, helping with chores was not associated with school engagement or grades in high-income households. Helping the family with chores may mitigate academic risks associated with low socioeconomic status (e.g., resource limitations and barriers to accessing enrichment opportunities). Consistent with this finding, two prior studies of predominantly White and South Asian children (ages 4–10) found that those from low-income communities showed higher levels of academic performance and behavioral regulation if they helped others more often, compared to if they helped others less (Armstrong-Carter, Miller et al., 2021; Flouri & Sarmadi, 2016). The current study extends this prior research by demonstrating that helping with chores may also be protective against academic risk associated with low socioeconomic status among Black adolescents. Although at least two other studies found that adolescents' provision of instrumental support (a combination of chores support and childcare) was associated negatively with academic grades (Armstrong-Carter & Telzer, 2021; Telzer & Fuligni, 2009), these studies did not examine differences by household income.

In low-income households, adolescents' experiences providing chores may be relatively more impactful because the household need is greater compared to that in higher-income households with more material resources and formalized supports. When adolescents feel that they are contributing tasks which are meaningful and necessary to meet their household's needs, they often gain a strong sense of purpose, fulfillment, self-efficacy, interpersonal connections, and positive emotions (Fuligni, 2019). These positive emotions and relational processes could help to buffer the financial, social, and psychological stressors associated with resource limitations. For instance, helping the family with chores may integrate youth more fully into the family system and create mutually beneficial, shared support networks (Cross, Taylor et al., 2018) which are particularly protective in homes where fewer material and educational resources are available and poverty-related stressors are more common. In addition, adolescents who feel that they are able to contribute meaningfully and help meet their family's needs may feel motivated to contribute to their family further by pursuing greater educational achievement (e.g., engaging with school, studying, performing well on homework assignments and quizzes), which helps to mitigate academic risk (Armstrong-Carter & Telzer, 2021; Hardway & Fuligni, 2006). Indeed, prior research has shown that adolescents who believe they should assist their family more strongly value academic achievement (Fuligni, 2001) and when adolescents feel more useful they report greater emotional wellbeing (Fuligni et al., 2021). Adolescents in low-income homes may feel that their provision of chores is relatively more impactful, and therefore derive more fulfillment from it, which in turn contributes to higher levels of school engagement and grades despite the academic risks typically associated with socioeconomic adversity. In addition, it

is important to note that pathways between support to the family and education are likely bidirectional. For example, adolescents who are performing well in school might have more time, energy or motivation to help more in the home.

In addition, adolescents from high-income households who provided more chores were suspended more frequently compared to those who provided less chores. In contrast, chores support was not related to the suspensions among youth from low-income households. Adolescents from higher-income homes who are suspended more frequently may be assigned chores by parents to provide structure or penalize behavioral challenges. This could explain why chores support and suspensions co-occur in high-income homes. In low-income homes, chores support may be a more every day, routine, occurrence that is not linked or contingent on behavior, but is motivated intrinsically and expected consistently due to greater household need and fewer resources. In one prior study, adolescents were more likely to help their families on days of greater household need when their mothers worked or felt fatigued (Tsai et al., 2013). Future research that measures when adolescents are motivated to help their families versus assigned to complete household chores may help to clarify why chores support is linked to more suspensions among high-income but not low-income youth.

4.3 | Providing childcare is linked to worse grades among low-income adolescents

In contrast to chores, providing childcare more frequently (e.g., taking care of a younger sibling) was associated with lower academic grades (i.e., lower likelihood of receiving As compared to Bs) only among Black adolescents from low-income households. This finding is consistent with the theory of Parentification (Burton, 2007; Hooper et al., 2014), which suggests that caring for younger children can interfere with adolescents' wellbeing and educational achievement when they are not able to access sufficient material supports or enrichment opportunities. In particular, providing childcare (as opposed to chores such as cleaning or cooking) may be uniquely challenging because it can involve a caregiving role commonly performed by adults (Burton, 2007; Hooper et al., 2014). Specifically, providing childcare can include high levels of responsibility and complex tasks such as feeding, dressing, washing, putting to bed, and supervising the younger child. Further, providing childcare can require high levels of material resources (e.g., money, food, clothing, enrichment opportunities) and ongoing investments of time (Burton, 2007; Hooper et al., 2014). In the context of these multiple conflicting responsibilities combined with fewer household resources, adolescents from low-income households may struggle to juggle both their childcare tasks and their academic tasks such as homework or studying (East & Hamill, 2013; Kramer & Hamilton, 2019; Siskowski, 2006) which in turn detracts from their academic performance over time.

Specifically, the challenges of providing childcare may be exacerbated in households with lower incomes due to heightened poverty-related stressors and worries, and the difficulties of juggling multiple challenges associated with resource limitations. For instance, managing childcare and school work may be particularly difficult if adolescents are responsible for acquiring food for the child without sufficient funds, or if the younger care recipient has more behavioral difficulties due to the stresses associated with low socioeconomic status and requires more supervision time and effort, or if the adolescent is experiencing heightened emotional stress due to household financial challenges (Kramer & Hamilton, 2019). In these contexts, providing childcare may be more likely to interfere with adolescents' time, energy, and emotional wellbeing that support academic endeavors. Further, adolescents from low-income households are more likely to live in single-parent households (US Bureau of Labor Statistics, 2020), and may therefore not have another parent to share their childcare tasks. In addition, adolescents in low-income households may provide childcare for multiple children which requires more time and energy, because low-income households tended to have more children in this sample. All these exacerbating factors could detract from adolescents' time and energy which otherwise could be directed toward homework and classwork. In contrast, adolescents who provide childcare in high-income households may have access to more supports which reduce psychological stress and mitigate academic risk associated with providing high levels of childcare, such as paid babysitters to help, two parents or guardians to help, or safe neighborhood parks to take the child. Future qualitative research could clarify whether these experiences and

others are mechanisms through which childcare relates to lower grades among low-income adolescents. Such work can yield crucial insight into how to promote the academic success of low-income adolescents and mitigate socioeconomic inequalities in young people's educational outcomes (Reardon, 2019). The fact that providing childcare in low-income households was linked to lower grades but not differences in engagement or number of suspensions suggests childcare may represent a barrier for low-income adolescents to invest time and energy in school and perform optimally, rather than impact emotional or behavioral engagement in school.

4.4 | No association between financial support and educational outcomes

This study also found that financial support was not associated directly or interactively with adolescents' school engagement, grades, or number of suspensions. There are several possible explanations for this finding. Some prior research has suggested that the benefits of earning wages during adolescence can in some circumstances outweigh the costs (Mortimer, 2010). Adolescents with work experience have reported greater self-confidence, self-efficacy, responsibility, and agency (Mortimer, 2010), which could mitigate the challenges of both working and being in school. In addition, although providing financial support was not associated with the particular educational outcomes measured in this study (i.e., school engagement, grades, and suspensions), financial support could be related to other aspects of education such as early departure from high school before graduation, or as absences from school not attributable to suspension. For instance, one third of adolescents who depart early from high school before graduating report they need to find employment and earn money, even though 88% of those still have passing grades (Bridgeland et al., 2006). In addition, 43% of adolescents who leave high school before graduating report that they miss too many days and feel they cannot catch up (Bridgeland et al., 2006). Finally, it also is possible that this study was underpowered to detect significant direct and interactive effects predicting financial support. Adolescents provided the lowest levels of financial support (compared to other types of support) in this sample. Future longitudinal research in samples with larger representation of adolescents who provide financial support should replicate this study's findings, and investigate whether financially contributing to the family is associated with other aspects of education such as graduation and number of school absences.

4.5 | Limitations and future directions

This study has several limitations. First, it is correlational and cross-sectional. Further, future longitudinal research can clarify whether support or educational measures temporally proceeded one another. Second, although this study distinguishes between four different types of support, future research may provide greater specificity by distinguishing between the recipients of support (e.g., Tsai et al., 2016), and the specific tasks with which adolescents helped. It also will be important to measure the amount of time and effort devoted to providing support (e.g., Telzer & Fuligni, 2009), as these factors may affect the adolescent's time for school work, extra-curricular activities, time with friends, and other developmentally-appropriate activities. Future research that studies adolescents' provision of financial support should consider how many hours per week adolescents worked, and whether they work on school nights, as these factors may be related to school absenteeism, for example. Future research also should measure other ways that Black adolescents help the family, such as helping siblings or family with hair care (Cross, Taylor et al., 2018) and translating.

Third, future research should examine possible moderating variables such as the presence of parental illness or disability in the home, or extended family members in the home, or whether the family is a single parent household. Caregiving for a family member who is aging or experiencing chronic mental or physical illness can be uniquely taxing (Armstrong-Carter et al., 2019), as these "caregiving youth" have been historically unrecognized and misunderstood (Olson, 2019). A prior study in this sample found that Black adolescents most frequently supported family members when they were ill (Cross, Nguyen et al., 2018). Further, it is increasingly common for adolescents to provide elder

care in the context of an aging population in the United States and increased reliance on younger family caregivers (Armstrong-Carter, Johnson et al., 2021). In addition, supporting the family in single-parent homes could either be associated uniquely with educational outcomes if adolescents provide higher levels of support in these circumstances because there are fewer adults in the home to share responsibilities.

Future research also should investigate whether the association between providing support and education differs for African American adolescents compared to Black Caribbean adolescents, because the amount and types of support that adolescents provide varies significantly by ethnicity, region, and family country of origin (Cross, Taylor et al., 2018). Further, varying cultural socialization and expectations of support (Morris et al., 2017) may modulate how supporting the family relates to education. Finally, future longitudinal research also can clarify whether the link between supporting the family and adolescents' educational outcomes changes across the adolescent period (e.g., from early to late adolescence), and persists further into adulthood as evidenced by graduation rates, college attendance and educational attainment.

5 | CONCLUSIONS

This study offers three primary contributions to developmental science. First, it extends prior research linking adolescents' contributions to the family and their educational outcomes (e.g., Armstrong-Carter & Telzer, 2021; Fuligni, 2001; Hardway & Fuligni, 2006; Telzer & Fuligni, 2009) in a sample of Black adolescents in the United States for the first time. This step is crucial to reflect the diversity of the U.S. population in developmental literature (Syed et al., 2018), especially given that Black adolescents make up almost 15% of the population (Census Bureau, 2020). Second, this study highlights the importance of distinguishing between at least four different types of support (i.e., chores, childcare, emotional, and financial support) to examine their unique associations with educational outcomes. This methodologically nuanced approach responds directly to recent calls to differentiate between adolescents' provision of qualitatively different types of support because they divergently impact adolescent adjustment (Armstrong-Carter et al., 2019; Tsai et al., 2016). Finally, this study revealed important heterogeneity by household income within the Black adolescent sample, such that the link between providing support and educational outcomes emerged primarily (although not exclusively) in low-income households. As such, the findings underscore the importance of investigating within-group heterogeneity in family processes among Black adolescents (Cross, Taylor et al., 2018; Gaylord-Harden et al., 2018; Taylor et al., 2022), particularly with attention to household socio-economic status. In sum, this study points to family support as an important factor that relates to educational experience and outcomes of Black adolescents in the United States. Providing support to the family during adolescence may be linked to both educational success and risk, depending on the type of the support and household socioeconomic resources available.

ACKNOWLEDGMENTS

This manuscript was prepared with support from a doctoral fellowship to Emma Armstrong-Carter funded by the Institute of Education Sciences, U.S. Department of Education, through Grant R305B140009 to the Board of Trustees of the Leland Stanford Junior University, and the Stanford Data Science Fellowship awarded to Emma Armstrong-Carter.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in National Survey For American Life Adolescent Supplement at <https://www.icpsr.umich.edu/web/RCMD/studies/36380?archive=RCMD&classification=RCMD.IX.A>.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Armstrong-Carter, E. (2023). Black adolescents' support to the family and educational outcomes: Differences by household income. *Social Development*, 32, 365–386. <https://doi.org/10.1111/sode.12627>